§16. Measurement of Island Width Made by LID Using Electron Cyclotron Emission Diagnostics on LHD

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Electron cyclotron emission (ECE) is useful to measure the electron temperature. The intensity of ECE is proportional to the electron temperature and the frequency corresponds to the location of the measurement. In LHD, the Michelson spectrometer is used to measure the ECE spectrum in the frequency range between 50 GHz and 300 GHz. Michelson spectrometer is absolutely calibrated with the black body radiation sources with the temperature of 293 K, 77 K and 800 K in order to obtain the electron temperature profile. Although the systematic error due to the calibration may be large, the noise level is less than 30 eV. Therefore the relative differences of the profile is easily distinguished. This feature is useful to analyze the island structure formation.

In a helical system, the geomagnetic field and small error field sometimes produce magnetic island structure near a rational surface. Local island diverter (LID) has a capability to control the width of the magnetic island. In LHD, the width of the m/n=1/1 magnetic island is minimized, when the LID coil current is -0.4 kA. Figure 1 shows the electron temperature profile at 10-O section measured by the Michelson system in cases of LID coil current of -0.4 kA, -0.6 kA, -0.8 kA and -1.2 kA. As the LID coil current increases, the flat region near R=4.25 m expands on the ECE temperature profile.

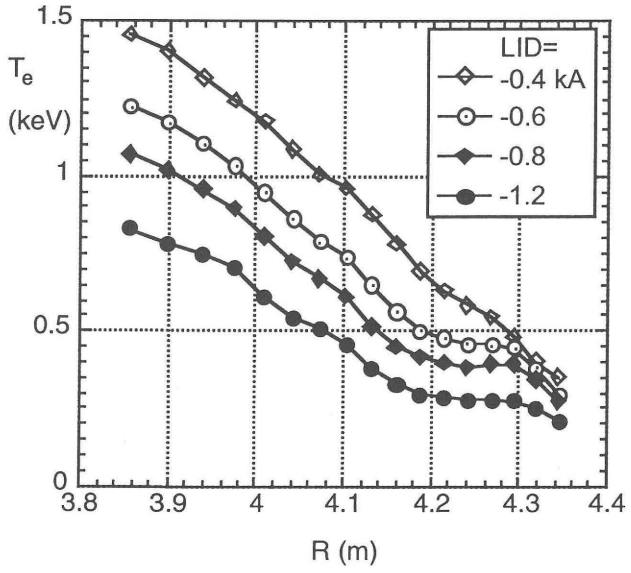

Fig. 1 The electron temperature profile of LHD plasma measured by the Michelson ECE spectrometer in cases of LID coil current of -0.4 kA, -0.6 kA, -0.8 kA and -1.2 kA.

Figure 2(a) shows the dependence of island width on the internal plasma energy measured by the diamagnetic probe. The LID coil currents are -0.4 kA, -0.6 kA, -0.8 kA and -1.2 kA. Figure 2(b) shows the dependence of island width on the line averaged electron density. Island width increases as the density increases. The effect of the internal energy on the island width looks smaller than the density. In Fig. 2(c), observed island width is compared with theoretical prediction under the assumption of no plasma pressure. The observed width is roughly consistent with the theory. The scattering of data may be due to the effect of the density.

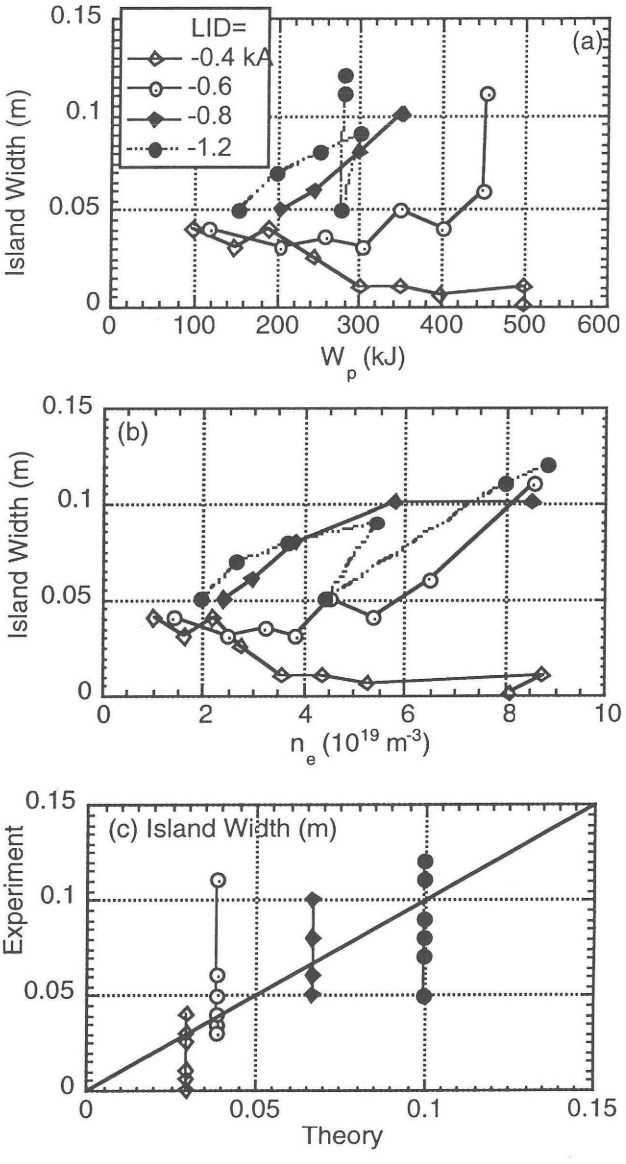

Fig. 2 (a) Island width in cases of LID coil current of -0.4 kA, -0.6 kA, -0.8 kA and -1.2 kA vs. the internal plasma energy measured by the diamagnetic probe. (b) Island width vs. the line averaged electron density. (c) Observed island width and theoretical prediction.